"Group Relationship of Salmonella ELISA Antibody Status of Grower-Finisher Hogs to Fecal Shedding Detectable by Culture,"

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Summary: From July 1998 through Nov1999, 15 groups of 30 pigs (450 total) were randomly picked (each total group size = 185 pigs), double ear-tagged, individually fecal and blood sampled, and placed into one of 5 separate finishing facilities (3 groups per facility) within a vertically integrated pork production system. Fecal and blood sampling was continued on individually identified animals at approximate monthly intervals for 3 or 4 times with the last pre-harvest samples being collected 2 to 18 days prior to slaughter (9 day avg.). All groups of hogs remained on full feed until loaded for shipment. Transportation time and methods, separation of hog groups during transit and at the packer, and lairage were approximately the same for all groups. Ileocecal lymph nodes and cecal/rectal combined fecal samples were collected at slaughter from individually identified hogs. Sera was tested by MIX-ELISA for Salm. antibodies and fecal and cecal/rectal fecal samples were cultured for Salm., serogrouped, and serotyped at NVSL.

Objective 1: **Compare the development of Salm. ELISA antibody with fecal shedding of Salm. in groups of hogs in grower-finishers.**

Objective 2: **Compare pre-harvest serum ELISA antibody to Salm. to post-harvest culture of Salm. from ileoceal lymph nodes.**

Objective 3: **Compare pre-harvest fecal culture for Salm. to post-harvest fecal culture from both the cecum and rectum.**

COMPARISON PROCEDURES: Comparisons for objectives 2 and 3 were first performed via a non-statistical protocol where individual and group correlation were measured. For a positive individual correlation, the formula used was: # positive (pre-slaughter)/positive (post-slaughter) > # negative(pre-slaughter)/positive (post-slaughter) or # positive (pre-slaughter)/negative(post-slaughter); or if all samples pre- and post-slaughter were negative or positive there was an individual correlation. For a positive group correlation the pre-slaughter positives and post-slaughter positives had to be within 15% or less of each other.

Data for Obj. 1, 2 and 3 were analyzed using mixed-model logistic regression in which the outcome was modeled as a function of the measurement taken at the individual pig level and accounted for the potential random effects of group in SAS

System for Mixed Models (1996). Groups were given the following designations: Pre-slaughter fecal culture =A; Slaughter cecal/rectal fecal culture = B; Pre-slaughter ELISA = C; Slaughter lymph node culture = D; Any fecal culture pre-harvest = E; and Any ELISA pre-harvest = F. A to B (Obj. 3), C to D (Obj.2), E to B, F to D, A to C, A to D, B to C, B to D, E to F, B to F, and E to B were compared.

The within group average daily gain (ADG) between culture positive/ELISA negative (PC), culture positive/ELISA positive (PCPE), ELISA positive/culture negative (PE), and culture negative/ELISA negative (N) were analyzed using the General Linear Model of SAS (1990) ANOVA and Duncan's Multiple Range Test. ADG Least Square Means were adjusted for starting weight and sex.

RESULTS: Objective 1 results: Groups started as relatively "Salmonella clean" by ELISA and culture on individual animal testing and then remained similar or varied greatly on subsequent monthly pre-harvest ELISA and culture samples. 183/234 (78%) ELISA positive 1 to 3 times were culture negative at all samples pre-harvest. 44/205 (21%) ELISA negative on all samples were culture positive on 1 to 3 samples pre-harvest; 105 isolates were cultured from 88 hogs pre-harvest and 269 isolates were cultured from 217 hogs at slaughter (2.5X more positive hogs and 2.6X more isolates at slaughter versus pre-harvest, respectively).
Objective 2 results: There was NO INDIVIDUAL ANIMAL CORRELATION between ELISA positive at sampling immediately pre-harvest and slaughter lymph node culture in 13/15 (87%) of groups, and NO GROUP CORRELATION between these same pre- and post-harvest tests in 8/15 (53%) of groups. Statistical analysis comparing these same tests was NON SIGNIFICANT ($P = 0.45$, comparison C to D). The value of any positive of multiple ELISA tests pre-harvest to predict positive lymph node culture at slaughter TRENDED TO BE SIGNIFICANT ($P = 0.04$, comparison F to D).
Objective 3 results: Using non-statistical criteria, there was NO INDIVIDUAL CORRELATION between fecal culture positive at the last sampling pre-harvest and slaughter cecal/rectal combined fecal culture positive in 14/15 (93%) of groups, and NO GROUP CORRELATION between these pre- and post-harvest tests in 10/15 (67%) of groups. Statistical analysis showed the value of an immediate pre-slaughter positive fecal culture to predict positive cecal/rectal combined fecal culture at slaughter was NOT SIGNIFICANT ($P = 0.07$, comparison A to B). The value of any positive of multiple fecal cultures pre-harvest to predict slaughter cecal/rectal fecal positive culture TRENDED TO BE SIGNIFICANT ($P = 0.047$, comparison E to B). Statistical analysis of the value of positive cecal/rectal positive culture at slaughter to predict positive lymph node culture at slaughter was HIGHLY SIGNIFICANT ($P < 0.0001$, comparison B to D).
ADG results: Data was available on 13/15 groups. Overall there was NO

STATISTICALLY SIGNIFICANT REDUCTION in ADG by PC, PE, or PCPE.

SUMMARY: Data on these 15 groups demonstrate there is NO SIGNIFICANT STATISTICAL DIFFERENCE and NO POSITIVE NON-STATISTICAL CORRELATION between immediate pre-slaughter ELISA compared to slaughter lymph node culture, and pre-slaughter fecal culture compared to cecal/rectal culture (tests 2 to 18 days apart [9 day average]). There was improvement in correlation when these same tests used multiple times pre-harvest were compared to respective slaughter tests, however, multiple tests are not practical. The lack of correlation between immediate pre- and post-harvest tests, the highly significant correlation between cecal/rectal fecal and lymph node culture at slaughter, the 2.6X higher number of Salm. isolates at slaughter verses all samples pre-harvest, and the different Salm. serotypes isolated pre- and post-harvest demonstrate evidence for Salm. contamination of live hogs at the slaughter facility and/or in transit, after hogs exit the farm. **These data show a disturbing difference between the Salmonella pre-slaughter status of hogs on the farm and their status at the packer after slaughter. These data demonstrate that the on farm, pre-harvest assessment of Salm. status of groups of hogs 2 to 18 days (9 day avg.) prior to slaughter minimized the confounding variables introduced when prediction of the immediate pre-harvest Salm. status was attempted at slaughter.**

Because of 21% false negative ELISA results, 78% ELISA positive/culture negative results (28% ELISA positive on 2 to 4 tests/culture negative), and the apparent lack of activation of the immune system to produce antibody by Salm. infection, as shown by no reduction in ADG in all groups of PC, PE or PCPE hogs, these data seem to indicate that MIX- ELISA does not provide enough information about the Salm. status of hogs on the farm, pre-slaughter, to be used in a pre-harvest certification program.

Considering that ELISA is designed to measure persistent antibody after Salm. infection, and immediate pre-slaughter ELISA samples were obtained 2 to 18 days (9day average) prior to slaughter, the results of ELISA from sera or meat juice collected at slaughter and substituted for ELISA results collected from sera immediately pre-slaughter (as in this study) may be similar when compared to pre-harvest fecal culture. In other words, MIX-ELISA results from samples at slaughter may have no significant correlation to fecal culture pre-harvest. If this is true. MIX-ELISA results from slaughter samples may be unreliable for classifying the immediate pre-harvest Salm. status of groups of finisher hogs.

Group comparisons of immediate pre-slaughter positive fecal culture and positive ELISA in these 15 groups showed fecal culture and ELISA consistently

(15% or less variation) classified groups of hogs relative to farms R, J, E, C, and D at 13/15 (87%) and 9/15 (60%), respectively. THESE DATA DEMONSTRATE FECAL CULTURE PRE-HARVEST GAVE THE MOST CONSISTENT ASSESSMENT OF SALM. STATUS OF GROUPS OF FINISHER HOGS ON THE FARM, IMMEDIATELY PRIOR TO SLAUGHTER.

CONCLUSION:

FROM DATA IN THIS STUDY IT SEEMS THAT A CLASSIFICATION SYSTEM FOR SALM. STATUS OF GROUPS OF FINISHER HOGS AND EVEN THE FARMS THEY ORIGINATE FROM COULD BE BASED ON FECAL CULTURE WITHIN ONE OR TWO WEEKS PRIOR TO SLAUGHTER.